EIS Analysis of Polyalkylthiophene Films Electrogenerated on Platinum and Carbon Felt Supporting Electrodes

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We obtained the Nyquist diagrams for polythiophene, poly(3-methylthiophene) and poly(3-hexylthiophene) in function of the films thicness and the potential in the anodic process and the cathodic process, in this way we saw the doped amd the undoped processes.

In the Figure 1 is possible to see the differents Nyquist diagrams in function of the potential and the cathodic or anodic processes. Are two main differences: a) the diagrams are function of the potential and b) for the same potential the behaviour its different in the anodic process and the cathodic process, indicative the histeresys fenomena.

The second step is to determinate the equivalent circuit for each polymer through the Boukamp program, that can explain the behaviour for each polymer in function of the thicness and the potential.

In the Figure 2 are representing the circuit equivalent circuits for each polymer. The correspondent to polythiophene has a resistance at high frecuency (Rs) and resistance parallel to capacitor, for a intermediate frecuency and low frecuency the behaviour is the same, a resistance in parallel with a capacitor. We havent seen the impedance diffusion in any case.

The equivalent circuit for poly(3-methylthiophene) is the almost the same, but here its possible to see the difusion impedance, and for the poly(3-hexylthiophene) we couldnt see the resistance in parallel with capacitor for intermediates frecuencys.

Figure 1.-Nyquist diagramas obtained at different potentials, in the oxidation process (0, 0.5, 0.7, 0.9 and 1.1V) and in the reduction process (0.9, 0.7 and 0.5V)

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Figure 2.- Equivalent electrical circuits. References: 1.- H.N. Dihn, P. Vansek, V.I. Birss, J. Electrochem. Soc., 146 (1999) 3324-3334. 2.- B.A. Boukamp, Equivalent Circuit 4.51, University of Twente, Enschede, 1993, The Netherlands